

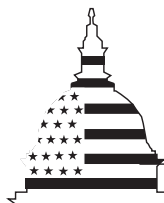


Report to the Chairman, Ad Hoc  
Subcommittee on Disaster Recovery,  
Committee on Homeland Security and  
Governmental Affairs, U.S. Senate

December 2007

# ARMY CORPS OF ENGINEERS

Known Performance  
Issues with New  
Orleans Drainage  
Canal Pumps Have  
Been Addressed, but  
Guidance on Future  
Contracts Is Needed



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Highlights of [GAO-08-288](#), a report to the Chairman, Ad Hoc Subcommittee on Disaster Recovery, Committee on Homeland Security and Governmental Affairs, U.S. Senate

## Why GAO Did This Study

Hurricane Katrina caused several breaches in the floodwalls along three drainage canals in New Orleans, contributing to catastrophic flooding. To restore the pre-Katrina level of hurricane-related flood protection, the Army Corps of Engineers (Corps) decided to acquire several large-capacity pumping systems. During the process of acquiring, testing, and installing the pumping systems, issues with the pump contract and operation of the pumping systems came to light, including several identified in a Corps Independent Team Report (ITR).

GAO was asked to evaluate the Corps' efforts to (1) develop contract specifications and award the contract, (2) address pumping system performance issues, (3) document contract modifications, and (4) reconcile contract payments. GAO reviewed contract and testing documents, observed the operation of the pumping system, and interviewed officials from the Corps, its consultants and contractors, and the ITR team.

## What GAO Recommends

GAO recommends actions to ensure that future contracts adhere to sound acquisition practices, even for expedited procurements, and to ensure that any required contract documentation is completed and filed in a timely manner.

The Department of Defense agreed with GAO's recommendations.

To view the full product, including the scope and methodology, click on [GAO-08-288](#). For more information, contact Anu Mittal at (202) 512-3841 or [mittala@gao.gov](mailto:mittala@gao.gov).

## ARMY CORPS OF ENGINEERS

### Known Performance Issues with New Orleans Drainage Canal Pumps Have Been Addressed, but Guidance on Future Contracts Is Needed

## What GAO Found

Schedule concerns drove the Corps' decisions in developing specifications for the pumping systems and awarding the contract, but the rush to award the contract resulted in deficiencies in key contract provisions. Specifically, the original factory test requirements were ambiguous, there were only limited provisions for on-site testing, and there were no criteria for acceptance of the pumping systems by the government. The Corps conducted an expedited competition to contract for the pumping systems and selected a supplier for contract award based largely on its ability to deliver the pumping systems by the June 1 start of the 2006 Atlantic hurricane season.

The Corps and the contractors have addressed and corrected known performance issues with the pumping systems. Concerns included hydraulic motor vibrations, the design of the hydraulic intake line, suspect pipe welds, and lower than expected pumping capacity. The pumping systems were installed prior to correcting these issues because the Corps believed it was better to have some pumping capacity along the drainage canals during the 2006 hurricane season rather than none, despite uncertainty over how much of the pumping system capacity would be available, and for how long, if needed. Between November 2006 and September 2007, the Corps and the contractors completed all of the repairs and reinstalled the pumping systems. Documents that GAO reviewed indicate that, as of September 2007, each pumping system had been successfully tested on site for at least 2 hours, thus providing greater assurance that they will perform as designed.

The contract files for the pumping systems contained the required documentation for the type and value of the contract and associated modifications, though, in a number of cases, documentation was inserted in the contract files several months after modifications were issued and only after the ITR reported its findings. While the ITR correctly noted the absence of some required documentation, GAO found that much of the specific documentation cited as missing was not required for the modifications in question because of the nature and value of these modifications. In addition, while the ITR found that it appeared as though the contractor developed the scope of work and pricing for some of the modifications without a subsequent analysis by the Corps, GAO found no instance of this occurring.

As of October 31, 2007, the Corps had paid the contractor about \$30.5 million of the \$33 million contract amount. In a few instances, the Corps made duplicate payments to the contractor. GAO found that these payments were due to Corps mistakes, not inappropriate billing by the contractor. GAO found no other cases of duplicate payments. The Corps plans to adjust for the duplicate payments by deducting the balance from remaining funds, including any incentive payments, owed to the contractor. According to Corps officials, final payment and reconciliation of the contract is expected by early 2008; however, it is unknown to what extent contract or pump performance issues will affect the final amount paid for the contract during the close-out process.

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## Abbreviations

cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
ERDC	Engineering Research and Development Center
FAR	Federal Acquisition Regulation
HI	Hydraulic Institute
ITR	Independent Team Report
MVD	Mississippi Valley Division
MWI	Moving Water Industries
RFP	Request for Proposals

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United States Government Accountability Office  
Washington, DC 20548

December 31, 2007

The Honorable Mary L. Landrieu  
Chairman  
Ad Hoc Subcommittee on Disaster Recovery  
Committee on Homeland Security and Governmental Affairs  
United States Senate

Dear Madam Chairman:

The greater New Orleans metropolitan area sits in the tidal lowlands of Lake Pontchartrain and is bordered generally on its southern side by the Mississippi River and the Gulf of Mexico. Due to the city's location and elevation, which averages six feet below sea level, the area has historically experienced many floods. In an effort to reduce such floods, a series of levees and other flood control structures have been built over the years to reduce that threat. However, hurricane-induced storm surges, waves, and rainfall continue to pose a threat to New Orleans. To avoid flooding in New Orleans from a rain storm, the city's Sewerage and Water Board pumps rainwater from the city into three drainage canals located at 17th Street, London Avenue, and Orleans Avenue, which then flows unrestricted into Lake Pontchartrain. While critical to prevent flooding from rainfall, these canals are vulnerable to storm surge from Lake Pontchartrain during hurricanes; consequently, floodwalls have been erected along both sides of the canals to protect against storm surge overtopping the canals and flooding the city.

On August 29, 2005, storm surge from Hurricane Katrina caused several breaches in the floodwalls along the 17th Street and London Avenue canals, contributing to catastrophic flooding in New Orleans. In its efforts to restore pre-Katrina levels of hurricane protection to New Orleans by the June 1 start of the 2006 Atlantic hurricane season (which generally runs from June 1 to November 30 each year), the U.S. Army Corps of Engineers (Corps), in late 2005, considered strengthening the drainage canal floodwalls but decided against this effort due to cost and time constraints. Instead, the Corps decided to install three interim closure structures or gates near the points where the canals meet the lake. These gates would be closed during major hurricane events to prevent storm surge from entering the canals and potentially overtopping or breaching the canal floodwalls and flooding the city. When the gates are closed, however, rainwater cannot drain from the three canals into Lake Pontchartrain, and

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large-capacity pumping systems are needed to pump water out of the canals and into the lake. Due to space constraints along the canals and the limited amount of time it had before the start of the 2006 hurricane season, the Corps decided to procure 34 large-capacity hydraulically powered pumping systems<sup>1</sup> to provide the most pumping capacity possible by June 1, 2006. In mid-2006, the Corps modified the contract to procure six additional hydraulic pumping systems, bringing the total number of hydraulic pumping systems to be installed along the three drainage canals to 40.<sup>2</sup>

During the process of acquiring, testing, and installing the hydraulic pumping systems for the drainage canals, issues with the operation of these pumping systems came to light. In response to your request, we issued a report on May 23, 2007, on the procurement process and award of the pumping system contract and the status of the efforts to address issues related to the performance of the pumping systems.<sup>3</sup> In June 2007, the Corps' Mississippi Valley Division (MVD) released a technical review report, known as the Independent Team Report (ITR). This report identified testing and performance-related issues regarding the hydraulic pumping systems similar to the issues we had identified in our May report and, in addition, raised potential issues related to the administration and documentation of contract modifications. The ITR was conducted by a three-person technical review team, which consisted of two Corps engineers from outside MVD and one engineer from MVD who acted as the team coordinator. According to ITR members, the New Orleans District was not offered the opportunity to provide official comments on the draft ITR; rather, an advisory panel from MVD reviewed the draft before its issuance in June 2007.

In this context, you asked us to update our May 2007 report and consider the ITR findings in our analysis. Specifically, you asked us to evaluate the

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<sup>1</sup>Unlike a more typical direct drive water pumping system where the motor or engine is directly coupled by a shaft to the pump it is turning, a hydraulic pumping system is one where pressurized hydraulic oil is used to transmit power from an engine to a pump impeller. This allows for greater flexibility in the placement and possible isolation of the engine from the pumping system because they are connected by hydraulic lines.

<sup>2</sup>During the 2007 hurricane season, the Corps also installed 14 portable hydraulic pumps along the 17th Street Canal and 19 additional direct drive pumps from another pump manufacturer along the 17th Street and London Avenue Canals.

<sup>3</sup>GAO, *U.S. Army Corps of Engineers' Procurement of Pumping Systems for the New Orleans Drainage Canals*, [GAO-07-908R](#) (Washington, D.C.: May 23, 2007).

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Corps' efforts to (1) develop the specifications for the pumping systems, (2) award the contract, (3) address pumping system performance issues identified during factory and on-site testing, (4) document modifications to the contract, and (5) reconcile payments made and amounts still owed to the contractor.

To address these objectives, we reviewed the Corps' plans for the interim gates and temporary pumping systems for the three New Orleans drainage canals. (Unless otherwise noted, the pumping systems discussed in this report are only the 40 60-inch hydraulic pumps installed at the three canals.) We reviewed documentation, including e-mails, correspondence, and other documents related to the solicitation process, contract specifications and other provisions, factory and on-site test results, performance requirements, contract modification files, payments to the contractor, and the Corps' plans for increasing pumping capacity through 2007. We visited the 17th Street, London Avenue, and Orleans Avenue Canals and observed the operation of the pumping systems. We interviewed officials from (1) Corps Headquarters, New Orleans District, other Corps districts, and members of the MVD's technical review team related to the contract and pump performance; (2) Moving Water Industries (MWI) Corporation and two other pump suppliers that bid on the solicitation; and (3) the architectural and engineering consulting firms under contract with the Corps that researched available pumping system alternatives, qualified pump manufacturers, pump delivery timelines, and costs and that helped design the canal gates and pumping stations. We conducted our work from September through December 2007 in accordance with generally accepted government auditing standards.

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## Results in Brief

Schedule concerns drove the Corps' decisions in developing specifications for the pumping systems, but the rush to award the contract resulted in deficiencies in key contract provisions. The Corps was committed to having as much pumping capacity as possible in place at the drainage canals by June 1, 2006—the start of the Atlantic hurricane season. Due to the compressed schedule and the limited space available for installation, and based on the limited market research conducted by the Corps' consultants, the Corps decided to use 60-inch hydraulic pumping systems rather than alternatives that would have involved longer delivery schedules or required more space. The Corps' consultants drafted contract specifications that closely matched those of one supplier, which, combined with the 60-inch pumping system requirement, resulted in that supplier being in the strongest position to compete for the contract. Further, the contract itself was not written as precisely as it should have



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been. Specifically, the original factory test requirements were ambiguous, there were limited provisions for on-site testing, and there were no criteria for acceptance of the pumping systems by the government.

Given the need to procure and install the temporary pumping systems before the start of the hurricane season, the Corps conducted an expedited competition to contract for the pumping systems. The Corps issued a competitive solicitation and received three proposals. Using established evaluation factors, the Corps rated MWI's proposal significantly higher than the other two proposals. The Corps selected MWI for contract award, in large part, because it determined that MWI was the competitor most likely to enable the agency to meet its June 1 deadline.

The Corps and the contractors have addressed and corrected known performance issues with the pumping systems. As identified in our May 2007 report and in the ITR, both factory and on-site testing revealed several concerns with some components of the pumping systems. Specific concerns identified during testing included undersized gear oil circulation motors, hydraulic motor vibrations, the design of the hydraulic intake line, suspect pipe welds, and lower than expected pumping capacity. Nevertheless, the pumping systems were installed as planned because the Corps believed it was better to have some pumping capacity along the drainage canals during the 2006 hurricane season rather than none. The Corps also believed that many of the issues identified during factory testing could be resolved after installation. Consequently, on June 1, 2006, the Corps had installed 11 pumping systems, and by July 2006, it had installed 34. However, both our May 2007 report and the ITR concluded that it was uncertain how much of the pumping systems' theoretical capacity would be available, and for how long, if needed during the 2006 hurricane season. The Corps and its contractors have since taken several steps to correct known performance issues with the pumping systems. These issues were addressed by replacing components that were undersized, such as motors and springs; redesigning and replacing the hydraulic intake lines; rewelding critical structural welds; and conducting additional pumping capacity tests. Between November 2006 and September 2007, the Corps and its contractors completed all of the repairs that were noted in the ITR and reinstalled all 40 pumping systems. As of September 2007, each pumping system has been successfully tested on site for at least 2 hours, thus providing greater assurance that they will perform as designed. According to Corps officials, all of the outstanding repairs have been completed and on-site testing indicates that the system is now fully operational.

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Contract files for the pumping systems, although incomplete at the time of the ITR review, now contain the required documentation for the type of contract and value of the associated modifications. In a number of cases, Corps officials inserted required documentation in the contract files several months after modifications were issued and only after the ITR reported its findings. The ITR correctly noted the absence of some required documentation. However, we found much of the documentation that the ITR specifically cited as missing—including requests for proposals, independent government estimates, certified cost or pricing data, technical analyses, and price negotiation memorandums—was not required, either because documentation was not relevant to the contract modifications in question, or the value of the modifications were below specified regulatory thresholds. In addition, while the ITR found that it appeared as though the contractor developed the scope of work and pricing for some of the modifications without a subsequent analysis by the Corps, we found no instance of this occurring. Rather, our review found that, for most of the contract modifications, there was evidence of some analysis by the Corps and extensive back and forth discussion, usually by e-mail, between officials from the Corps and MWI.

As of October 31, 2007, the Corps had paid the contractor about \$30.5 million of the \$33 million contract for the 40 hydraulic pumping systems and has since planned to reconcile mistaken payments it made. The Corps made payments to the contractor after receiving invoices for items delivered, such as drive units, pumps, and services. In most instances, the Corps retained about 20 percent of each invoice to ensure that the contractor was not overpaid. The ITR identified a few instances where the Corps made duplicate payments to the contractor. Our review found that these duplicate payments involved mistakes by the Corps, not inappropriate billing actions on the part of the contractor. We found no additional cases where the Corps made duplicate payments to the contractor. According to the Corps contracting officer, the duplicate payments will be corrected by deducting the balance from retained funds or by not paying outstanding invoices. In addition, the contract also has an incentive clause of up to \$5 million for early delivery, but the Corps has withheld any payment until the final acceptance of the pumping systems occurs. The contract also has a penalty for late delivery. The Corps will determine whether or not a penalty will be assessed as part of the close-out process. According to Corps officials, final payment and reconciliation of the contract, including any incentive payments, will be completed after final acceptance of the pumping systems.

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While most of the issues identified to date related to testing, pump system performance, and payments have been addressed by the parties, there may still be issues that arise and need to be resolved during contract closeout. The Corps expects contract closeout to take place during the early part of calendar year 2008.

We are recommending that the Corps develop procedures to help ensure that all future contracts, including those awarded for expedited procurements, contain the terms and conditions needed to ensure that items contracted for meet the government's needs, and that key contract actions are adequately documented in a timely manner. In commenting on a draft of this report, the Department of Defense concurred with our recommendations.

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## Background

Since its founding in 1718, the city of New Orleans and its surrounding areas have been subject to numerous floods from the Mississippi River and hurricanes. The greater New Orleans metropolitan area, composed of Orleans, Jefferson, St. Charles, St. Bernard, and St. Tammany parishes, sits in the tidal lowlands of Lake Pontchartrain and is bordered generally on its southern side by the Mississippi River and the Gulf of Mexico. Lake Pontchartrain is a tidal basin about 640 square miles in area that connects with the Gulf of Mexico through Lake Borgne and the Mississippi Sound.

Many hurricanes have struck the area over the years, including Hurricane Betsy in 1965, Hurricane Camille in 1969, Hurricane Lili in 2002, and Hurricane Katrina in 2005. The hurricane surge that can inundate coastal lowlands is the most destructive characteristic of hurricanes and accounts for most of the lives lost from hurricanes. Because of such threats, a series of flood control structures, including concrete floodwalls and levees, have been constructed in and around the New Orleans metropolitan area (see fig. 1).

## Barriers of Earth and Concrete

Levees and floodwalls that protect against flooding from both the Mississippi River and hurricanes are built by the U.S. Army Corps of Engineers and are maintained by local levee districts. The Corps and the local districts share the construction cost of hurricane levees, while the Mississippi River levees are a federal project. Local levee districts also build and maintain nonfederal, lower-elevation levees with construction money from each district's share of property taxes and state financing.

## HEIGHT ISN'T EVERYTHING

Different factors permit Lake Pontchartrain levees of varying elevations to withstand an 11.5 foot storm surge plus several feet of waves:

- Levees on higher ground and separated from the water by 5 miles of marshland need to be only 12.5 feet tall
- Levees fronted by boulders and concrete rubble breakers can be about 14 feet high
- Levees without any breakers need to be about 17 feet tall or taller
- Seawalls on the water must be 22 feet high

Note: The height and shape of a levee is based on the roughness of the area over which waves pass to reach the structure and the slope of the structure.

## Levees and floodwalls

- Interior parish
- Hurricane protection
- Mississippi River

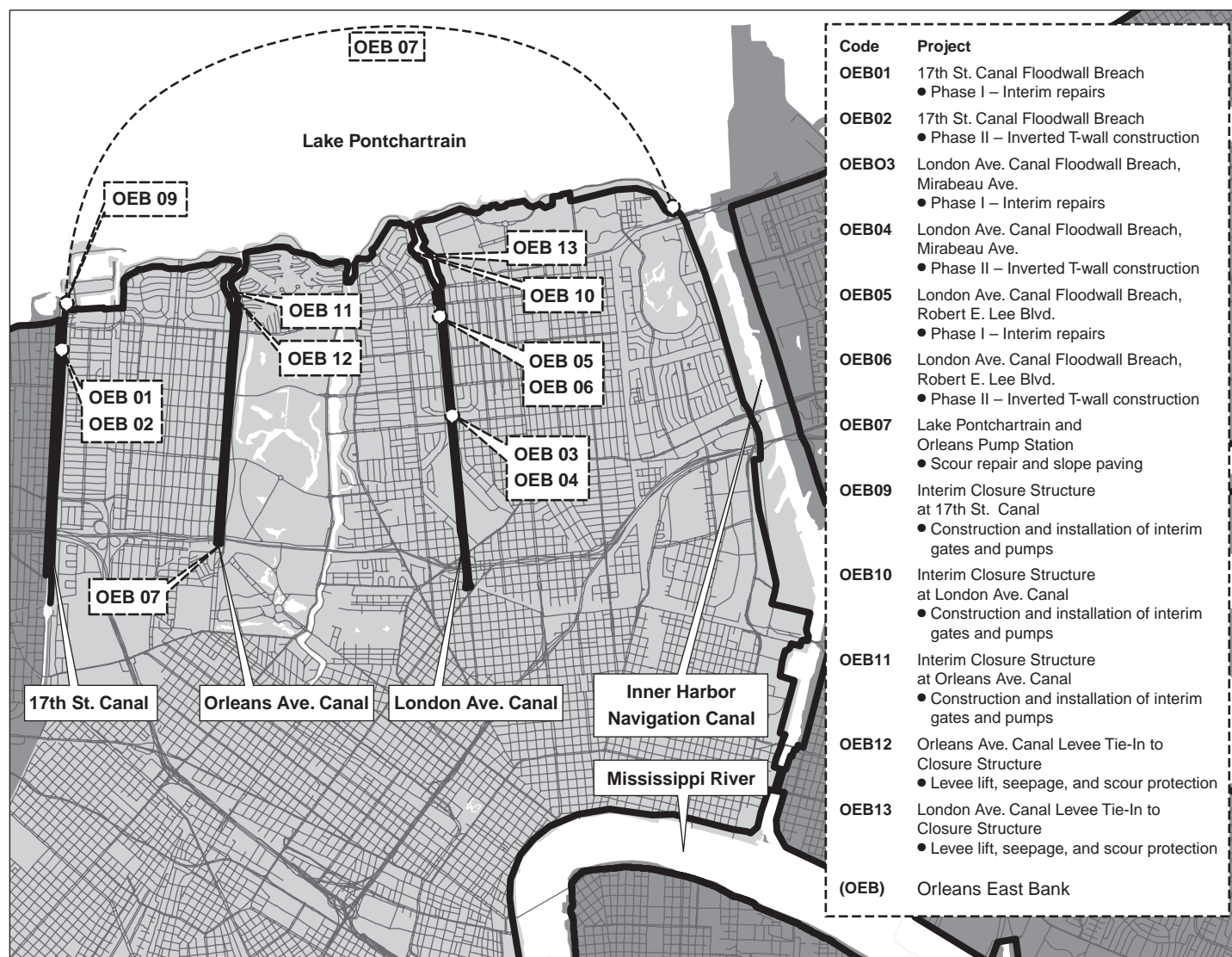
On August 29, 2005, Hurricane Katrina came ashore near Buras, Louisiana, about 60 miles southeast of New Orleans, with wind speeds of up to 127 miles per hour and a storm driven wave surge of up to 30 feet. The size and strength of the storm and subsequent flooding resulted in one of the largest natural disasters in U.S. history. Storm waters overtopped floodwalls and levees in Louisiana's Orleans and neighboring parishes, causing widespread flooding, many billions of dollars of property damage,

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and more than 1,300 deaths. The Corps estimates that more than one-half of the 269 miles of federally constructed levees and floodwalls in these parishes were damaged by the storm's winds and floodwaters.

Through a combination of permanent and temporary measures, the Corps planned to restore the level of hurricane protection to the New Orleans area that existed prior to Hurricane Katrina by June 1, 2006. To restore the pre-Katrina level of protection in a period of about 9 months, the Corps had to work quickly and, in some instances, engineer temporary solutions because not all of the repairs could be completed in time. One such temporary solution was needed along the Orleans East Bank, located south of Lake Pontchartrain, from the 17th Street Canal to the Inner Harbor Navigation Canal, and along the western bank of the Inner Harbor Navigation Canal to the Mississippi River. About 19 miles of levees and floodwalls are located along the Orleans Lakefront, the Inner Harbor Navigation Canal, and three drainage canals—17th Street, London Avenue, and Orleans Avenue—which drain rainwater from New Orleans into Lake Pontchartrain. A total of about 1 mile of levees and floodwalls was damaged along the 17th Street Canal and two sides of the London Avenue Canal, resulting in flooding of New Orleans (see fig. 2).

**Figure 2: Orleans East Bank in New Orleans, Louisiana, and Repair Project Sites**

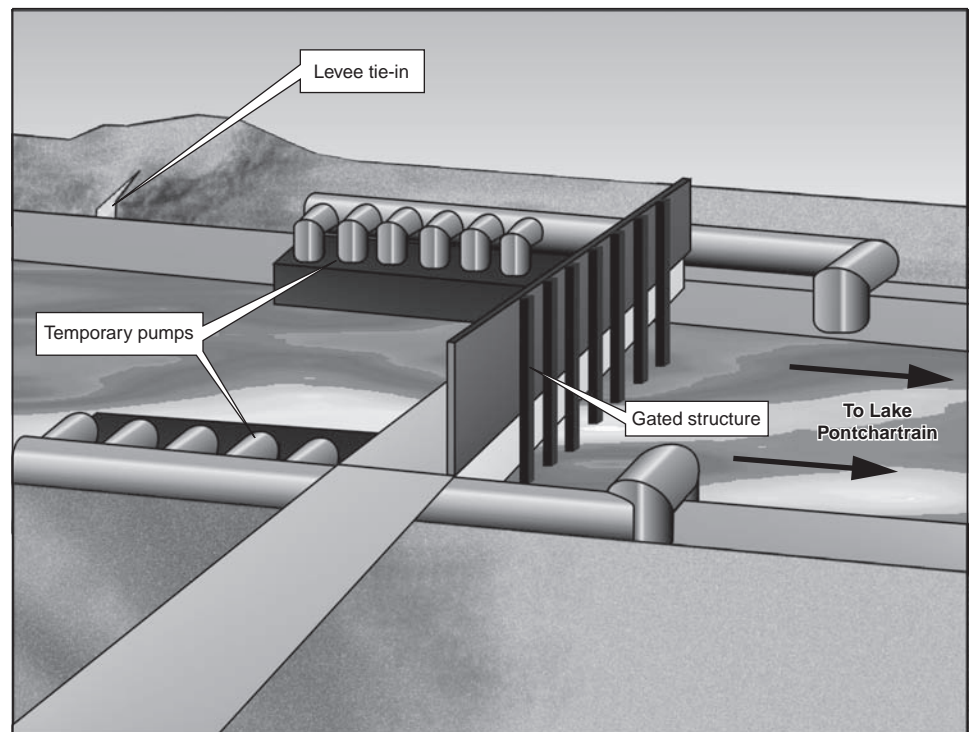


Source: U.S. Army Corps of Engineers.

The city's three drainage canals are critical to avoid flooding in New Orleans from a rain storm. During rain events, the city's Sewerage and Water Board pumps rainwater from the city into three drainage canals at 17th Street, London Avenue, and Orleans Avenue, which then flows unrestricted into Lake Pontchartrain. According to the Corps, the maximum amount of water that the Sewerage and Water Board can pump into these drainage canals is 10,500 cubic feet per second (cfs) at the 17th

Street Canal, 7,980 cfs at the London Avenue Canal, and 2,690 cfs at the Orleans Avenue Canal. Because permanent structures and repairs could not be completed on the three drainage canals by June 1, 2006, the Corps decided to install temporary pumping systems to provide protection to the area for 3 to 5 years until permanent structures can be constructed (see fig. 3). The Corps chose to install three gates and temporary pumping systems near the points where the 17th Street, London Avenue, and Orleans Avenue drainage canals meet Lake Pontchartrain. These gates are intended to stop hurricane-induced storm surge from Lake Pontchartrain from entering the canals and possibly overtopping or breaching the canal floodwalls, which would flood the city. However, because the gates prevent the drainage canals from draining water from the city into the lake when the gates are closed during a hurricane event, temporary pumping systems are needed to pump water out of the canals and into the lake.

**Figure 3: Graphic of Interim Gates and Temporary Pumps**



Source: U.S. Army Corps of Engineers.



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Due to the hurricane damage sustained by the floodwalls bordering the canals, the Corps established the following safe water levels for each of the drainage canals—6 feet for the 17th Street Canal, 5 feet for the London Avenue Canal, and 8 feet for the Orleans Avenue Canal. The water level in each of these canals must be maintained at or below the safe water level in order to ensure that the already weakened canal floodwalls are not breached. Further, the total capacity of the temporary pumping systems at the interim gated closure structures that is necessary to accommodate a 10-year rainfall event<sup>4</sup> without exceeding the safe water levels is 7,700 cfs at the 17th Street Canal, 5,000 cfs at the London Avenue Canal, and 1,900 cfs at the Orleans Avenue Canal. The hydraulic pumping systems installed by the Corps at the Orleans Avenue Canal were sufficient to maintain the safe water levels during a 10-year rainfall event. However, the hydraulic pumping systems installed at the 17th Street and London Avenue drainage canals could provide about 4,000 cfs and 2,700 cfs, respectively. In order to ensure that each pumping station had the needed capacity to pump enough water during a 10-year rainfall event, the Corps used a separate contract to acquire and install an additional 11 direct drive pumps and 14 portable hydraulic pumps at the 17th Street Canal, increasing the capacity from about 4,000 cfs to about 9,200 cfs. The Corps also installed 8 additional direct drive pumps at the London Avenue Canal, increasing the capacity from about 2,700 cfs to about 5,200 cfs. Table 1 provides the total number of pumps and pumping capacity at the 17th Street, London Avenue, and Orleans Avenue Outfall Canals.

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<sup>4</sup>A 10-year rainfall event is a storm that has a probability of occurring once in 10 years, also described as having a 10 percent chance of happening in any year.



**Table 1: Total Number of Pumps and Pumping Capacity at the 17th Street, London Avenue, and Orleans Avenue Outfall Canals, as of November 2007**

	17th Street Canal			London Avenue Canal			Orleans Avenue Canal		
	Temporary outfall pumps <sup>a</sup>	Capacity needed for 10-year rainfall event	Sewerage and Water Board maximum pumping capacity	Temporary outfall pumps <sup>a</sup>	Capacity needed for 10-year rainfall event	Sewerage and Water Board maximum pumping capacity	Temporary outfall pumps <sup>a</sup>	Capacity needed for 10-year rainfall event	Sewerage and Water Board maximum pumping capacity
Type of pump	No. of pumps	Cubic feet per second (cfs) <sup>b</sup>		No. of pumps	Cubic feet per second (cfs) <sup>b</sup>		No. of pumps	Cubic feet per second (cfs) <sup>b</sup>	
Hydraulic	18	4,000		12	2,700		10	2,200	
Direct drive	11	4,000		8	2,500		N/A	N/A	
Portable hydraulic	14	1,400		N/A	N/A		N/A	N/A	
<b>Total</b>	<b>43</b>	<b>9,200<sup>c</sup></b>	<b>7,700</b>	<b>20</b>	<b>5,200</b>	<b>5,000</b>	<b>10</b>	<b>2,200</b>	<b>1,900</b>

Source: GAO analysis of Corps data.

<sup>a</sup>Pump capacity numbers are approximate and are based on rated pump values.

<sup>b</sup>Cubic feet per second (cfs) is a unit of measure for flow. One cfs is equivalent to about 449 gallons per minute or 646,000 gallons per day.

<sup>c</sup>The upper limit on the total pumping capacity at the 17th Street Canal has been set at 9,200 cfs because of the number of pumps at the canal.

Although these additional pumps allow the total pumping capacity at the three canals to maintain the capacity needed to pump water out of the canals during a 10-year rainfall event, the capacity is still not sufficient to match the maximum pumping capacity of the Sewerage and Water Board's pumps. As a result, during a hurricane event, some flooding might occur in some parts of the city from rainfall, although it is likely that this flooding would be significantly less than that which occurred from the overtopping and breaches of the canal walls during Hurricane Katrina. Appendix II provides the pumping capacity trends for the 17th Street, London Avenue, and Orleans Avenue drainage canals from June 1, 2006, through November 30, 2007.

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## Commitment to Meet Schedule Drove Specifications but Resulted in Deficiencies in Some Key Contract Terms

The Corps' efforts to develop the specifications for the pumping systems were driven by its commitment to have as much pumping capacity as possible in place at the drainage canals by June 1, 2006—the start of the first Atlantic hurricane season after Hurricane Katrina. Due to the compressed schedule and the limited space available for installation, and based on the limited market research conducted by the Corps' consultants, the Corps decided to use 60-inch hydraulic pumping systems rather than alternatives that would have involved longer delivery schedules or required more space. The Corps' consultants drafted contract specifications that closely matched those of one supplier, which, along with the 60-inch pumping system requirement, resulted in that supplier being in the strongest position to compete for the contract. Further, the contract itself was not written as precisely as it should have been. Specifically, the original factory test requirements were ambiguous, there were limited provisions for on-site testing, and there were no criteria for acceptance of the pumping systems by the government.

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## Space and Schedule Requirements Were Key Considerations in Developing Specifications

The decisions made by the Corps during the procurement of pumping systems at three New Orleans drainage canals were driven largely by space and schedule considerations. The Corps began the acquisition process by contracting with two architectural and engineering consultant firms (consultants) to determine available technical options that could meet the Corps' schedule, space, and pumping capacity needs; conduct the associated market research; and survey pump equipment suppliers. On the basis of their technical analysis, the consultants concluded that the use of hydraulic-driven pumps was the best alternative for the Corps because electric-driven direct drive pumps would need auxiliary equipment that would require more space for installation and would have a longer delivery time. They also determined that using hydraulic pumps less than 60 inches in diameter would require more pumps to be installed and require added space to provide the same amount of pumping capacity.<sup>5</sup>

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<sup>5</sup>The 60 inches refers to the diameter of the pumps' impeller, which moves the water. Simplistically, pumping capacity is proportional to the square of the pump diameter. For example, using 42-inch hydraulic pumps would require nearly twice the number of pumping systems to achieve the same capacity as 60-inch hydraulic pumps.

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## Specifications Closely Matched Those of One Supplier, but Key Contract Provisions Were Deficient

Corps consultants drafted contract specifications that closely matched those of one supplier. The consultants conducted limited market research and found that at least two suppliers had specifications for a 60-inch hydraulic pump. One of those suppliers was MWI, a company that the consultants had spoken with as they were developing the design for the gates and pump stations along the drainage canals. The consultants met with MWI and also contacted at least two other pump manufacturers regarding their pumps. Of these suppliers, the consultants identified MWI as the only supplier who had actually manufactured a 60-inch hydraulic pump with a 60-inch impeller, the mechanism that drives water through the system. Another pump manufacturer had a design for a 60-inch pump, but it included only a 54-inch impeller. The consultants believed that MWI could deliver the 34 60-inch pumping systems that the Corps needed on schedule.

The Corps did not have an existing technical specification for a 60-inch hydraulic pump. The consultants drafted a specification for the Request for Proposals (RFP) based on technical specifications and descriptions of the pumps contained in catalogs published by MWI and another manufacturer. The consultants told us that they had provided the Corps with a generic specification because any reference to a specific supplier had been removed. However, our analysis of the RFP's equipment specifications indicates that they more closely matched MWI's than the other manufacturer's catalog descriptions. In fact, the testing specifications used for the RFP were nearly identical to those published by MWI, which included an open sump test requirement. After the other manufacturer complained that the open sump test requirement was restrictive because only MWI had an open sump, the Corps amended the RFP to delete this requirement. This open sump test requirement was incorporated into the contract at the time of award, however, because it was offered by MWI as part of its proposal.

Other contractual testing and acceptance criteria were ambiguous, inadequate, or missing altogether. Specifically, the contract did not clearly state whether factory flow and head testing was required of each pump, the on-site testing requirement merely stated that there should be no leaks, and there were no final acceptance criteria in the contract. Terms and conditions in contracts should be clear and complete so that the parties fully understand their obligations and that potential disputes can be avoided. To date, Corps and MWI have been able to address identified deficiencies in the contract, which were largely caused by the perceived need to move forward expeditiously. However, the extent to which these or other contract issues may lead to disputes between the parties will not

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be known until the time of contract closeout, currently scheduled for early 2008.

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## The Corps Used a Streamlined Solicitation Process and Awarded the Pumping Systems Contract to the Highest-Rated Competitor

Given the need to procure and install the temporary pumping systems before the June 1 start of the 2006 hurricane season, the Corps decided to use a streamlined process to contract for the pumping systems. Like most other federal agencies, the Corps has statutory authority to use other than full and open competition procedures when the agency's needs are of an unusual and compelling urgency. Using this authority, the Corps streamlined parts of the acquisition process. The RFP was issued on January 13, 2006, and required that the contractors' proposals be submitted by January 18, just 5 days later. Normally the solicitation would allow for a response period of at least 30 days.

The Corps received three proposals in response to its RFP. Suppliers submitted pricing information and technical proposals and made oral presentations to the Corps.<sup>6</sup> The Source Selection Evaluation Board, whose voting members consisted of three Corps officials, evaluated offers using four technical evaluation factors identified in the RFP in descending order of importance: (1) technical approach, (2) project management, (3) past performance, and (4) small business or small disadvantaged business participation. The solicitation also provided that, when combined, these technical evaluation factors were weighted approximately equal to price.

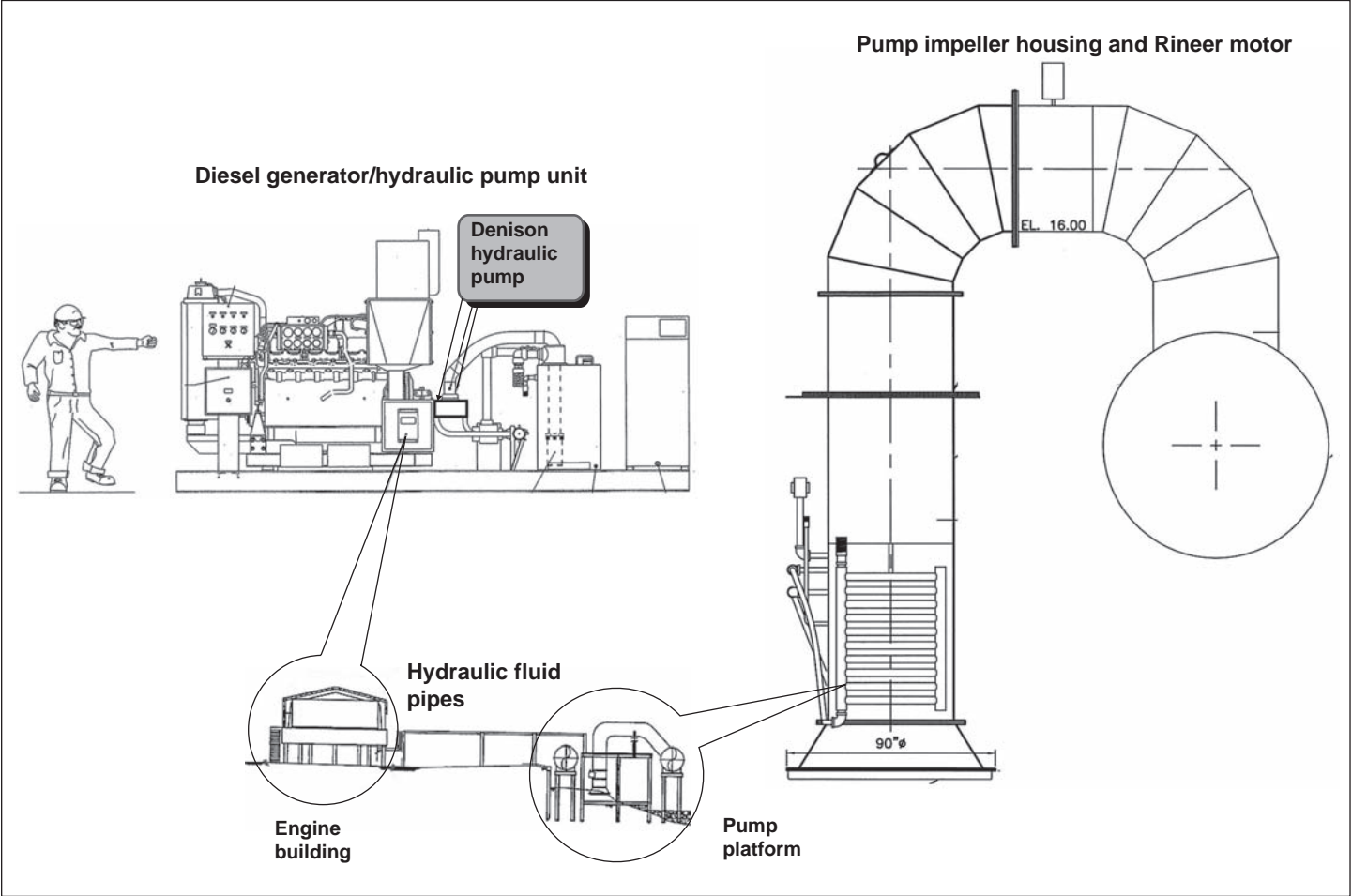
The Source Selection Evaluation Board rated MWI's proposal significantly higher than the other two proposals. MWI's proposal included commitments from suppliers and subcontractors to deliver the pump components needed by MWI to assemble the pumps. The Corps believed MWI represented the best chance of meeting the Corps' critical deadline of June 1, 2006. MWI offered a price of \$26.6 million, which was within 2.8 percent of the government estimate of \$25.6 million. The contracting officer determined that MWI's price was fair and reasonable and awarded a firm, fixed-price contract to MWI on January 27, 2006. The contract also contained an incentive of up to \$5 million that MWI could earn for early delivery. To date, the Corps has increased the contract price by about \$6 million for required pump modifications and for six additional pumping

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<sup>6</sup>Corps officials informed us that videotapes were made of the oral presentations, but due to technical difficulties the sound did not record.

systems, bringing the total number of hydraulic pumping systems acquired to 40. Figure 4 shows a diagram of the hydraulic pumping system.

Figure 4: Hydraulic Pumping System



Source: U.S. Army Corps of Engineers.

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## The Corps and the Contractors Have Addressed Pumping System Testing and Performance Issues

The Corps and its contractors have addressed and corrected the pumping system testing and performance issues identified by both our May 2007 report and the ITR. Factory testing, which occurred from March 2006 through May 2006, revealed several issues with some components of the pumping systems, and concerns were raised that the pumping systems would not perform as intended. On May 2, 2006, the Corps modified the original contract, replacing the original testing requirements with new procedures because of schedule and performance concerns. Beginning in June 2006, however, even though all of the problems identified during factory testing had not been resolved, the systems were installed as planned because the Corps believed it was better to have some pumping capacity along the drainage canals during the 2006 hurricane season rather than none. The Corps also thought that most of the issues identified during factory testing could be resolved after installation. The Corps and the contractors took several steps to correct the known performance issues after installation and, as of September 2007, all of the pumping systems have been reinstalled and all of the outstanding repairs have been completed. According to Corps officials, the results of on-site testing now show that the 40 hydraulic pumping systems are fully operational and final acceptance of the pumping systems is scheduled for the beginning of calendar year 2008.

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## Factory Testing Requirements Were Modified to Focus on Deficiencies Identified

On May 2, 2006, the Corps issued modification No. 4, “revised test procedures,” to the contract. According to the contracting officer responsible for oversight of the pumping system contract, these revised testing procedures replaced the original factory testing requirements with new testing requirements. The contract initially required each pump and hydraulic power transmission system to be factory pressure tested statically and dynamically.<sup>7</sup> In addition, full-size flow and head testing was to be witnessed by the government prior to shipment of the pumping systems.<sup>8</sup> The pump flow and head testing was to be conducted in an open sump at the manufacturer’s testing facility in accordance with Hydraulic

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<sup>7</sup>According to Corps officials, static testing involves checking for external leaks around the seals of the pump units. Dynamic testing involves setting the pumps in water and spinning the impeller, while using a dynamometer to determine the load of the impeller.

<sup>8</sup>According to Corps officials, flow and head testing are conducted to determine the predicted capacity of water a pump can discharge over time. Flow measures how much water can be pumped. Head measures how high the water can be pumped.

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Institute (HI) standards<sup>9</sup> and in the presence of a registered professional engineer. According to the contracting officer, modification No. 4 replaced these testing procedures. The modification required, among other things, testing the hydraulic drive units for a minimum of 3 hours and utilizing previous model tests of the pump design to predict the pump capacity. Further, the modification required all pumps to be pressure tested for 90 minutes.

According to New Orleans District Corps officials responsible for oversight of the contract, the original testing requirements were interpreted by a Corps inspector and the ITR to include full-size flow and head testing of each of the pumps. Furthermore, the ITR concluded that modification No. 4 did not specifically delete the original testing requirements and, therefore, assumed the testing that had been conducted did not meet the contract requirements regarding full-size flow and head testing for each pump in accordance with HI standards. Based on this assumption, the ITR concluded that the contractor owed the government a refund because it had not completed the testing required in the contract. The ITR's reading of the modification may have overlooked the modification's purpose, however, which was to adjust the required testing to focus on those elements of the pumps in need of further refinement, given the limited time available. We believe the ITR may have reached this conclusion because it did not discuss the intent of the "revised test procedures" modification to the original testing requirements with either the contracting officer or the Corps' technical officials. Officials from the New Orleans District told us that it was never the intention of the Corps to interpret the testing requirements as requiring every pump to be full-size flow and head tested in accordance with HI standards—only static and dynamic tests were originally required of each pump. Corps technical and contracting officials said the revised testing procedures contained in the modification were developed to focus on the mechanical issues that had

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<sup>9</sup>HI is the largest association of pump industry manufacturers in North America. The institute provides industry standards for the effective application, testing, installation, operation, and maintenance of pumps and pumping systems.

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been identified and, therefore, replaced the original testing requirements, which included allowing the use of model test results in lieu of HI tests.<sup>10</sup>

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## **Pumping System Performance Issues Have Been Addressed by the Corps and the Contractors**

The Corps and the contractors have addressed and corrected the concerns raised about some components of the pumping systems during factory and on-site testing. As noted in our May 2007 report and in the ITR, the primary concerns identified during testing included undersized gear oil circulation motors, hydraulic motor vibrations, the design of the hydraulic intake line, suspect pipe welds, and lower than expected pumping capacity. As a result of the concerns identified during testing, the Corps had no assurance that the pumping systems would operate to capacity if needed during the 2006 hurricane season. Nevertheless, the pumping systems were installed as planned because the Corps believed it was better to have some pumping capacity along the drainage canals during the 2006 hurricane season rather than none. On June 1, 2006, the Corps had installed 11 pumping systems, and by July 2006, it had installed 34, although it is uncertain how much of the theoretical capacity of these pumping systems would have been available, and for how long, if needed during the 2006 hurricane season. The Corps also believed that many of the issues identified during factory testing could be resolved after installation. After installation, the Corps and its contractors took several steps to correct known performance issues with the pumping systems. The main performance issues, and the ways the Corps and the contractors addressed each of them, are described in more detail below.

### **Undersized Motors**

During factory testing, the Corps observed that the gear oil circulation pump motors were overheating, which resulted in the failure of some of the motors. MWI determined that the pump motors were too small. All of the motors were eventually replaced with larger gear oil circulation motors, resolving the problem.

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<sup>10</sup>The Corps later became concerned that it might not be able to determine whether the pumping system met specifications because none of the pumping systems had been operated at design conditions. The Corps, therefore, issued modification No. 17, which required the contractor to revert to full performance and mechanical testing as required under the original contract for one pumping system. The rest of the pumping systems would be tested only for mechanical integrity.



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## **Hydraulic Motor Vibrations**

During on-site testing in August 2006, the hydraulic motors were experiencing greater than normal vibrations. According to the ITR, this condition could have led to the failure of the equipment. Initial analysis of the problem indicated that there may have been a hydraulic short in the Rineer hydraulic motor that drives the main pump impellers. The motor manufacturer made modifications to the motor, and preliminary testing of the motors in late August 2006 appeared to confirm that these modifications eliminated the vibrations. However, upon further testing, vibrations were still present to varying degrees. Additional on-site testing was performed, and in late November 2006, it was determined that the vibrations were due to undersized springs in the Rineer hydraulic motors. The motor manufacturer replaced the undersized springs with heavier springs. According to Corps officials, on-site tests witnessed by the government after the installation of the new springs and measurements conducted by a third-party contractor document that the pumping systems now operate with no apparent vibration issues.

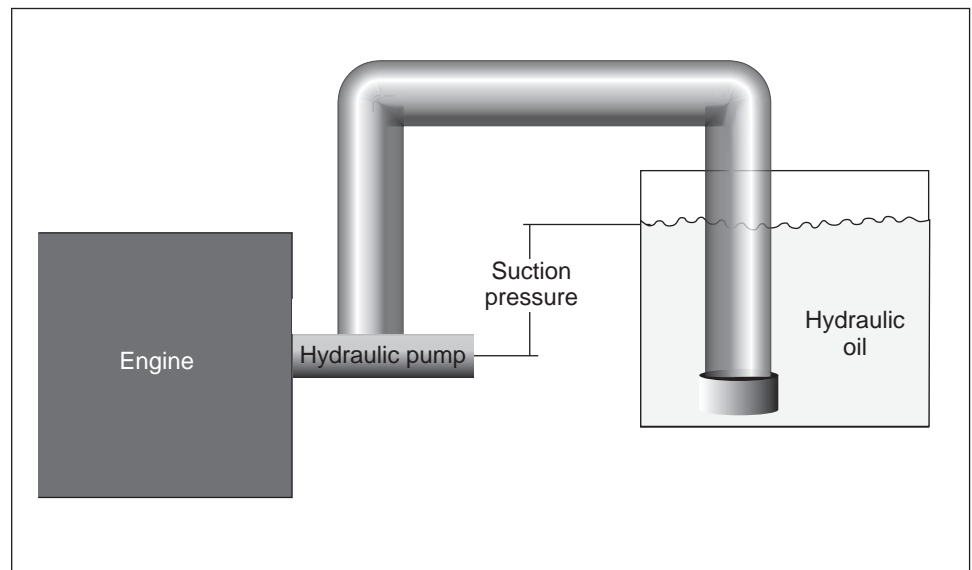
## **Hydraulic Intake Line**

Because of concerns that the hydraulic intake lines could adversely affect pumping performance, the Corps requested that MWI redesign and reinstall the hydraulic intake lines on all of the pumping systems. During factory testing, the Corps observed a high rate of failure of the Denison hydraulic pumps on the drive units. The Denison motors pump the hydraulic fluid from a reservoir to the Rineer motor which then turns the pump impeller. A preliminary assessment revealed that the majority of the issues identified in the factory were caused by air entrainment (or dry run condition) in the hydraulic pumps. The dry run condition was attributed to air getting into the hydraulic system upon initial start-up of the drive unit. To eliminate the dry run issue, two interim changes were made to the system until a more permanent fix could be implemented: (1) a check valve was installed on all of the hydraulic intake lines, and (2) the pump start-up procedure was modified so that the system was started at a lower speed and gradually increased to the normal operating speed.

The ITR concluded that the pumping systems would probably not have performed as designed because the inclusion of a check valve would require priming the pump prior to start-up and the original intent of the design was to allow for unmanned operation of the equipment. Both Corps and MWI officials stated that the ITR was incorrect in assuming that the pumps would have to be primed using the check valve at every start-up.

Instead, these officials stated that the pumping systems would have operated as intended because using this valve to prime the Denison pumps is only necessary immediately after maintenance is performed on the system. Additionally, according to a Lake Borgne Levee District official, this pump design has been successfully used for about 20 years without having to prime the pumps prior to start-up. Nevertheless, in order to ensure that air would not be pulled into the hydraulic pumps, causing failure of the system, the Corps requested that MWI redesign the hydraulic intake system to provide for a flooded suction without a siphon. Figure 5 shows a drawing of the original hydraulic pump design with siphon.

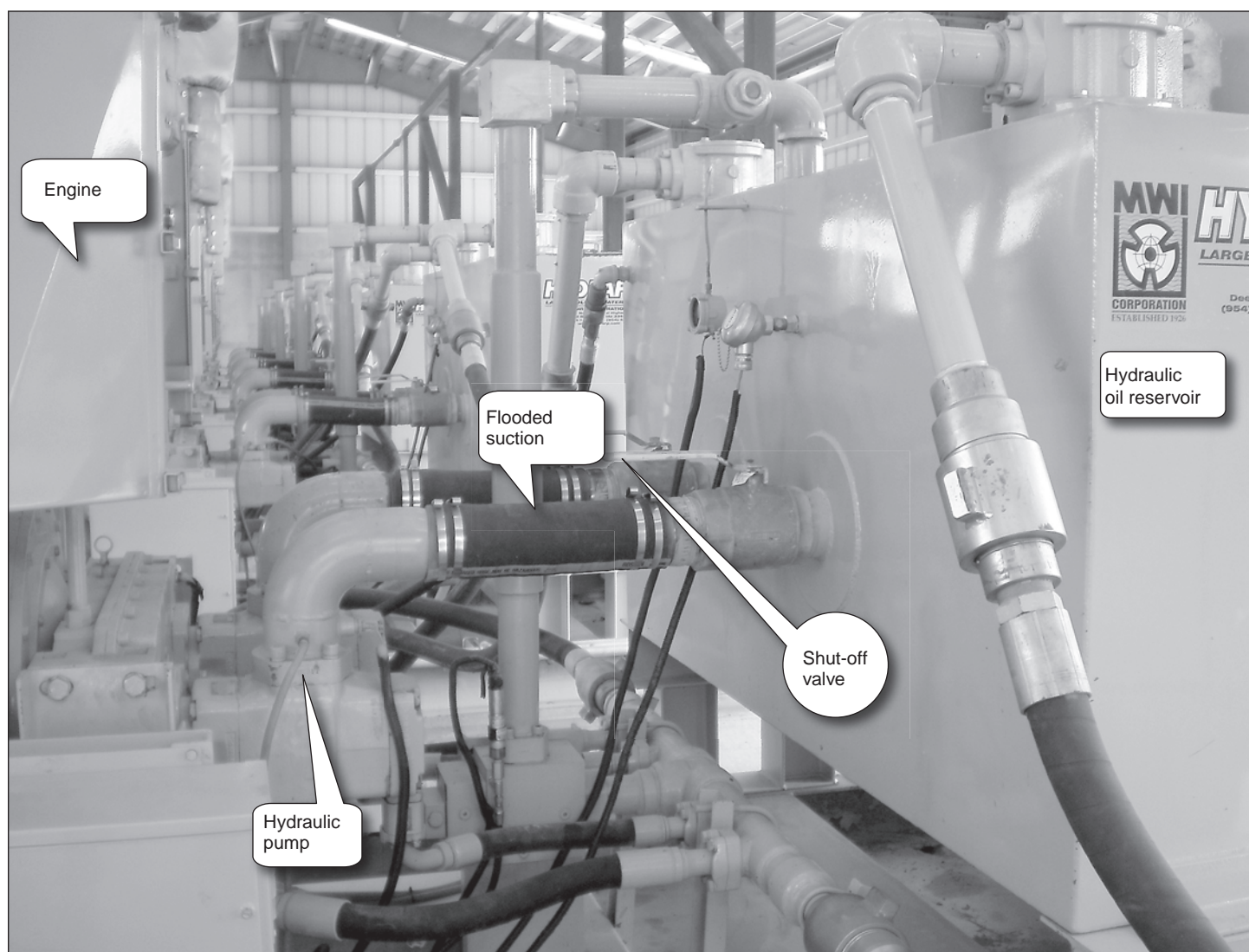
**Figure 5: Original Hydraulic Pump Design with Siphon**



Source: Moving Water Industries Corporation.

Corps officials from the New Orleans District emphasized to us that the redesign was requested to more adequately meet their needs, not because of concerns about the pumping systems operating as intended. MWI subsequently agreed to modify the design of the hydraulic intake line at the request of the Corps. According to Corps officials, by the end of July 2007 and at its own expense, MWI had redesigned and reinstalled the new flooded suction design on all 40 pumping systems (see fig. 6).

**Figure 6: Reinstalled Hydraulic Pump without Siphon**



Source: GAO.

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## **Welding**

Because of questionable welds identified on the pump housing,<sup>11</sup> the Corps decided to replace certain welds to ensure they would not fail during pump operations. Upon inspection of the pump housing, the Corps determined that some of the welds on the pump housing may not be sufficient. While MWI provided the Corps with a “fit for service letter” for all of the welds on the pump housing and an extended warranty, the Corps decided that it was prudent to replace the welds on the pump housing below the base plate (the segment of the pump that is below the water level) in order to ensure that the welds would not fail during pumping operations. All of the necessary welds have been corrected, and the Corps plans to negotiate this additional cost during contract closeout.

Additionally, issues were raised about the adequacy of the welds on the hydraulic piping, which carries high pressure hydraulic fluid from the Denison pump to the Rineer motor. The hydraulic piping was subsequently visually inspected and pressure tested to 1.5 times its operating pressure as part of the quality control process. The testing results indicated that the piping was adequate for transmitting power from the diesel engine to the water pump.

## **Pumping Capacity**

Initial pumping capacity testing indicated that the pumping systems may not have been performing at the design capacity level. In April 2006, MWI conducted full-size factory flow and head tests on the hydraulic pumps. A representative from the Corps’ Engineering Research and Development Center (ERDC) reviewed these test results and concluded that the test results showed that the pumps would operate at about 96 percent of the specified capacity. However, according to the ITR, these tests were not conducted in accordance with HI standards and, therefore, were invalid.

In August 2006, on-site flow and head testing was conducted at the canals. In order to test the pumping systems, the interim gates were closed and water was pumped into the canal by the city’s Sewerage and Water Board to raise the water level in the canal to the elevation necessary for the pumping systems to be tested. However, because adequate water levels in

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<sup>11</sup>The pump housing consists of 60-inch piping, which carries the water pumped out of the canal and discharges it into Lake Ponchartrain.

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the canal could not be achieved to replicate design conditions, the pumps could not reach a fully primed condition. The Corps decided to invert the discharge pipes in order to enable the pumps to reach a primed condition with less than design water conditions in the lake. This facilitated testing of the pumping systems and allowed measurements to be recorded and analyzed.

In September 2006, a representative from ERDC was consulted and performed on-site flow and head tests of pumping systems at the London Avenue canal. A month later the Corps and ERDC performed the same tests at the 17th Street canal. Data collected from these on-site tests revealed that the pumping systems were working near the appropriate capacity. Based upon the on-site testing results and upon suggestion from the ERDC representative, all of the discharge pipes at all of the canals were inverted and cut at a 30 degree angle, which allows the pumps to prime at lower canal water elevations and enhances the flow rates (see fig. 7).

Figure 7: Discharge Pipes at the London Avenue Canal



Source: GAO.

In November 2006, another full-size factory flow and head test was conducted by MWI and ERDC. However, due to constraints at the testing facility, the full-size factory test, which was done in consultation with the ERDC representative, was completed with deviations from the HI standards. This test revealed that the pumping capacity ranged from 93.6 to 97.6 percent of the design specification and performed without problems during the 2 days of testing. According to Corps officials, MWI further agreed to construct a model test to confirm the pumping systems

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would perform within HI standards. In September 2007, a Corps ERDC official witnessed a model test conducted by MWI and prepared a report, which concluded that the pumping systems would operate at 98.6 percent of the design capacity. According to Corps officials, these results are within acceptable limits and any issues remaining with the final pumping capacity will be negotiated at contract closeout.

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### Pumping System Acceptance Is Near Completion

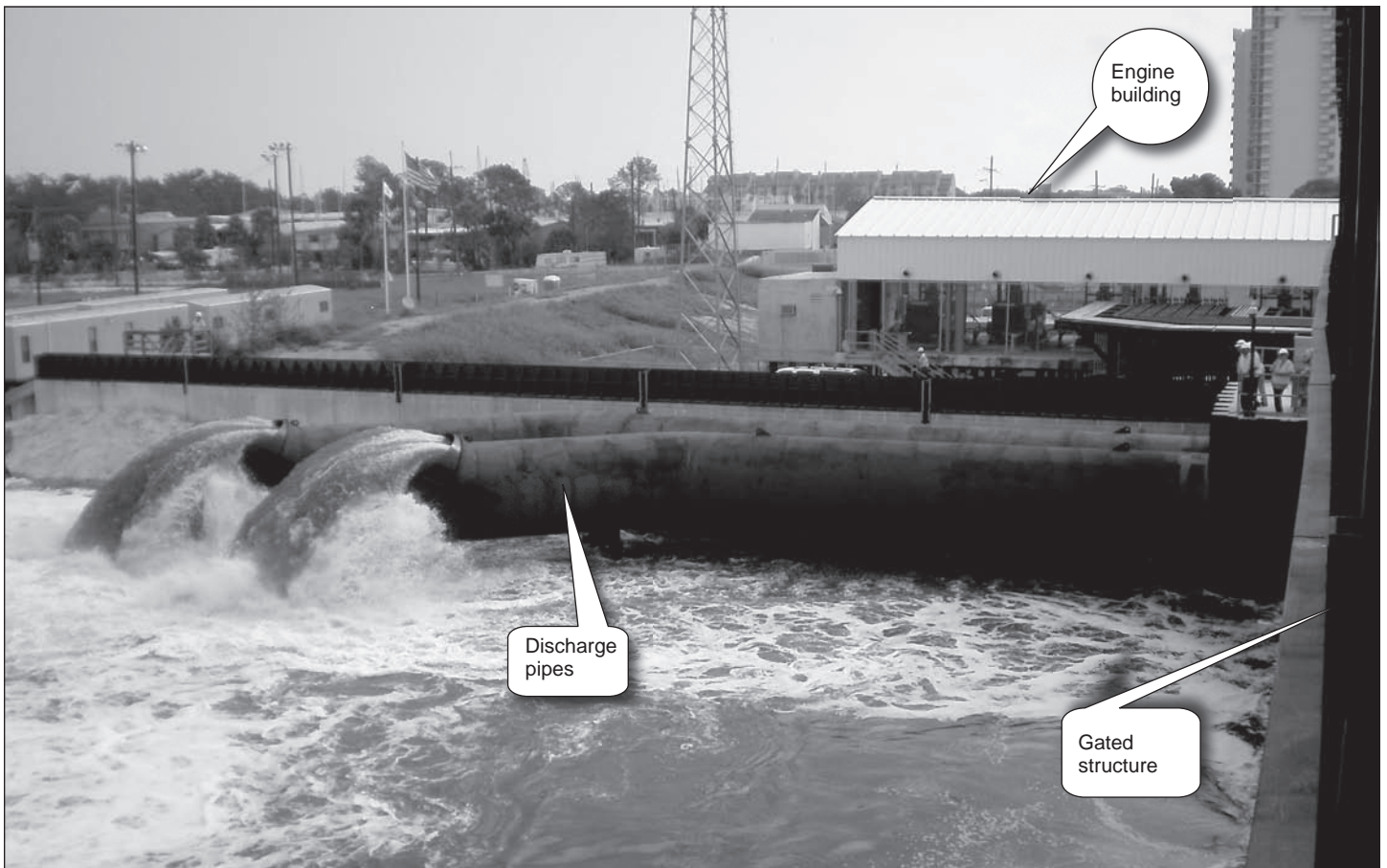
According to Corps officials, the Corps plans to make final acceptance of the pumping systems during the beginning of calendar year 2008. The original pumping system contract lacked clearly defined on-site testing procedures, requiring only that the pumps and hydraulic equipment be tested for leaks. In light of the various issues surrounding the pumping systems, the Corps and MWI agreed that it was necessary to show that all of the pumping systems could operate at a steady state after installation. According to Corps and MWI officials, a major challenge with on-site testing of the pumping systems is simulating the amount of water that would be present in the canals and the lake during a storm event. Under normal conditions, when there are low water levels in the canals, it is not possible to test each pump system for an extended period of time, and any tests conducted cannot approach the design capacity of the pumping systems. Due to this limitation, the Corps subsequently developed specific pumping system acceptance testing procedures that, among other things, include running each pumping system continuously for 2 hours. Corps officials told us that because most of the issues associated with the pumping systems occurred within the first 45 minutes of operation, the 2-hour testing period for each pumping system was sufficient.

In its June 2007 report, the ITR team concluded that at the time of their review in September 2006, the pumping systems would not perform as intended because of issues encountered in factory testing in early 2006. Since September 2006, there have been a number of analyses, changes, and additional testing of the pumping systems to address these earlier concerns. For example, between November 2006 and September 2007, the Corps had completed all of the repairs that were outstanding at the end of the 2006 hurricane season and which were noted in the ITR, and reinstalled all 40 pumping systems. In addition, as of September 2007, each pumping system had been successfully tested on site for at least 2 hours, providing greater assurance that they will perform as designed during future hurricane seasons. On September 27, 2007, GAO officials witnessed the pumping systems performing at both the 17th Street and London Avenue Canals (see fig. 8). According to Corps officials, because all of the outstanding repairs have been completed and on-site testing indicates that



the system is now fully operational, final acceptance of the pumping systems and the contract closeout is expected to be completed early in calendar year 2008.

**Figure 8: Hydraulic Pumping Systems Performing at the 17th Street Canal, September 27, 2007**



Source: GAO.



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## Contract Files Remained Incomplete for Months, but Currently Contain Required Documentation for the Type and Value of Procurement

Contract files for the pumping systems, although incomplete at the time of the ITR review, now contain the required documentation for the type of contract and the value of the associated modifications. In a number of cases, however, Corps officials inserted required documentation in the contract files several months after modifications were issued and only after the ITR reported its findings. While the ITR correctly noted the absence of some forms of required documentation, we found that much of the documentation specifically cited—including requests for proposals, independent government estimates, certified cost or pricing data, technical analyses, and price negotiation memorandums—was not required for the modifications in question. In addition, while the ITR found that it appeared as though the contractor developed the scope of work and pricing for some of the modifications without a subsequent analysis by the Corps, we found no instance of this occurring. Rather, our review found that, for most of the contract modifications there was extensive back and forth discussion, usually by e-mail, between officials from the Corps and MWI.

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## Significant Documentation Added to the Contract Files Only after the ITR Review

The ITR team reviewed 18 of the first 30 contract modification files and reported that many lacked significant documentation. Specifically, the ITR identified 13 modification files with deficiencies—most pertaining to documentation of the Corps' determination of fair and reasonable pricing. Our review confirmed that significant documentation was added to the files only after the ITR team issued its report. We reviewed the files for the 32 post-award modifications, focusing in depth on the files related to the 13 modifications found by the ITR team to contain deficiencies, as well as 2 additional modifications that were issued after our May 2007 report and the ITR review. Of the modifications we reviewed in depth, 10 contained internal memorandums, prepared by the contracting officer after the fact, to document price reasonableness or the events supporting the modification. Another 2 modifications contained undated memorandums of price reasonableness signed by the contracting officer. Finally, of the eight purchase request and commitment forms on file, five were prepared on the same date to retroactively document the availability of funds for modifications that were issued 9 to 17 months earlier. Documentation in some of the files, however, suggests that the availability of funds was determined through other means at the time the modifications were signed.

In response to the ITR, the Corps' contracting officer acknowledged that the contract files could have been better managed but stated the Corps felt it was more important to get the pumps installed in a timely manner. In order to do this, the Corps issued the modifications with the intention of

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settling all outstanding issues with the contractor before closing out the contract. The Corps agreed with the ITR, however, that certain documentation was missing and took corrective actions to complete the files. The contracting officer, whom the ITR team did not meet with for their review, noted that because many of the people working on the pumping systems procurement were rotating through the District Office, they may not have completed or submitted all of the necessary paperwork before leaving. Even though it is currently complete, preparing documentation months after an event occurs increases the likelihood that the documentation may contain inaccuracies or ambiguities, which make it difficult to resolve any disputes that may arise.

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### Many Specific Documents Cited by the ITR as Missing Were Not Required

As of October 2007, the contract modification files appeared up to date and consistent with Federal Acquisition Regulation (FAR) requirements. While the ITR correctly noted the absence of some forms of required documentation, much of the documentation specifically cited by the ITR—including requests for proposals, independent government estimates, certified cost or pricing data, technical analyses, and price negotiation memorandums—was not required for the modifications in question.<sup>12</sup> In some respects, it appears the ITR treated the pumping systems contract as if it were for construction rather than supplies. Different documentation requirements apply to these types of contracts.

Ten of the modifications we reviewed in-depth increased contract costs and, therefore, required documentation of fair and reasonable pricing.<sup>13</sup> While independent government estimates are one technique that can be used to analyze price and are required for construction contracts, they are not specifically required for supply contracts, such as the contract for the pumping systems. Nonetheless, the Corps obtained—and included in the files after the ITR review—independent government estimates for six of the modifications.

None of the 10 modifications with additional costs that we reviewed in-depth required the contractor to provide certified cost or pricing data. Specifically, we found that 7 of the modifications fell under the threshold

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<sup>12</sup>The documentation cited by the ITR would not have impacted the weaknesses we identified earlier in this report.

<sup>13</sup>Fourteen of the 32 modifications resulted in increased contracting costs.

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requiring cost or pricing data.<sup>14</sup> The contracting officer determined that cost or pricing data was not required for another modification because it combined separately priced changes from 2 previous modifications that were each below the threshold. Finally, for 2 modifications related to the purchase of six additional pumps, the contracting officer concluded that adequate price competition existed from the base contract and, therefore, additional pricing data was not required. At least some information on pricing provided by the contractor was included in the files for all 10 of the modifications that involved additional costs.

According to the FAR, when contractor certified cost and pricing data are not required, price analysis shall be used to determine a fair and reasonable price. While the FAR provides numerous analysis techniques, including the use of independent government estimates, it does not require the use of any one method. For 8 of the modifications we reviewed, the Corps' contracting officer documented price analysis and negotiations with the contractor through signed internal memorandums for the files, and for 2 modifications, used price negotiation memorandums.<sup>15</sup> In addition, while not required, the Corps obtained internal technical analyses for 3 of the modifications we reviewed in depth to determine the reasonableness of MWT's proposals. Table 2 summarizes GAO's analysis of the ITR's findings regarding missing documentation in the contract files.

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<sup>14</sup>The threshold for certified cost and pricing data was increased from \$550,000 to \$650,000 on September 28, 2006.

<sup>15</sup>While price negotiation memorandums can be used to document price analysis findings, such as fair and reasonable pricing, they are not specifically required for documenting the agreement negotiated between the contractor and agency.

**Table 2: GAO Analysis of the ITR Findings**

Documentation cited as missing by ITR	GAO analysis and applicable FAR references
Request for proposal	Not always required for contract modifications. Under the FAR, the Standard Form (SF) 30, Amendment of Solicitation/Modification of Contract may be used at the discretion of the contracting officer. FAR section 15.210(b).
Independent government estimate	A comparison of contractor-proposed prices with an independent government estimate is one of many examples of price analysis techniques, but is not specifically required for contract modifications. FAR section 15.404-1(b).
Contractor certified cost or pricing data	Certified cost or pricing data is required for modifications of any negotiated contract expected to exceed the current threshold of \$650,000 except when adequate price competition exists or when commercial items are being acquired. In addition, this requirement does not apply when unrelated and separately priced changes below the threshold are included for administrative convenience in the same modification. FAR sections 15.403-1, 15.403-4.
Price, cost, or technical analysis	Price analysis shall be used when contractor cost or pricing data are not required. Various price and cost analysis techniques are listed in the FAR, including the use of independent government estimates. However, none of the listed techniques are specifically required. In addition, the contracting officer may, but is not specifically required to, request that personnel with specialized knowledge, skills, experience, or capabilities perform technical analyses of contractor proposals to determine reasonableness. FAR section 15.404-1.
Price negotiation memorandum	While price negotiation memorandums can be used to document price analysis findings, such as fair and reasonable pricing, they are not specifically required for documenting the agreement negotiated between the contractor and agency. These memorandums document the principal elements of the negotiated agreement. FAR section 15.406-3.

Source: GAO.

## File Documentation Establishes Independence of Corps Decision Making

In addition to contract documentation issues, the ITR also reported that it appeared, in some circumstances, as though the contractor developed the scope of work and pricing for the modifications without a subsequent analysis by the Corps. We found no instance of this occurring. Rather, our review of the files indicate that, for most of the contract modifications, there was extensive back and forth discussion, usually by e-mail, between personnel from the Corps and MWI. These discussions focused on the causes of and solutions to technical issues, as well as the costs of corrective actions.

While each of the modifications was unique, modification No. 2 is illustrative of many of the contract modifications we reviewed. Specifically, shortly after award of the contract, the Corps determined that it needed the capability to control the pumps from a remote location, since in the event of a hurricane the operator would be required to seek shelter in a control booth. The Chief of Engineering from the Corps prepared a request to modify the contract to require master pump control panels. The request contained detailed specifications of what was required and

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estimated that the additional cost would be \$150,000. The contracting officer sent the request to MWI and asked for a cost proposal. MWI replied through an e-mail that repeated the specifications provided to it by the Corps and offered a price of \$188,699. The Corps requested additional support for the price, and MWI responded with a copy of the quote it had received from its supplier, pricing for MWI's markup, and the additional work MWI would perform. A Corps engineer reviewed this information and informed the contracting office that MWI's proposed price was reasonable. The Corps issued a contract modification with the specifications it developed at the price quoted by MWI. As was the case for a number of modifications, there was no contemporaneous price reasonableness document signed by the contracting officer; rather, an undated "after the fact" memorandum concluding that MWI's price for the modification was reasonable was added to the file.

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## **The Corps Has Not Overpaid the Contract and Has Plans to Reconcile Payments Made in Error**

As of October 31, 2007, the Corps had paid the contractor about \$30.5 million of the \$33 million contract for the 40 hydraulic pumping systems and has plans for reconciling mistaken payments it made. The Corps made payments to the contractor only after receiving invoices from the contractor for delivered items and services. In most cases, the Corps only paid 80 percent of each invoice and held the other 20 percent as retained funds in order to ensure the contractor was not overpaid and that any performance issues were addressed.

The ITR identified a few instances where the contractor had received payment more than once for the same item. Our review confirmed that this did occur. We found, however, that these payments were made in error by the Corps and did not indicate any improper behavior on the contractor's part. Specifically, on December 6, 2006, the Corps received one invoice requesting payment for three drive units and three pumps valued at about \$2.2 million because they were complete, and MWI believed that they could be delivered if the Corps wanted them at that time. On the same day, the Corps notified MWI that it could not pay for the pumps and drive units until they were actually delivered. MWI then e-mailed the Corps, requesting that they ignore the original invoice and stating that they would send new invoices for the drive units and pumps upon shipment. The Corps subsequently received three separate invoices, each requesting payment for one drive unit and one pump. However, the Corps paid all of the invoices, including the invoice that the contractor told them to ignore. As a result, the Corps paid twice for the same three pumps and three drive units. According to the Corps' contracting officer, the duplicate payments will be corrected by deducting the balance from withheld funds and not

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paying some outstanding invoices. Our review found no other instances where duplicate payments were made to the contractor. We also found 14 instances where the contractor sent invoices to the Corps for work completed, which have not been paid. The net effect is that the contractor has not been overpaid under the contract.

On June 8, 2007, the Corps sent a letter to MWI providing an explanation as to why the Corps had not paid these outstanding invoices, and describing how the Corps planned to reconcile the duplicate payments made in January and February 2007 by subtracting the amount of the outstanding invoices from any additional invoices it received. From July through October 2007, the Corps made four additional payments to the contractor from the payments it had withheld, totaling about \$1.8 million. The Corps has still not made final payment for the outstanding amount remaining on the contract. In addition, the Corps has withheld payments related to an early delivery incentive of approximately \$5 million until the final acceptance of the pumping systems.<sup>16</sup> According to Corps officials, the final payment and reconciliation of the contract, including any incentive payments or penalties, will be settled with the contractor after final acceptance of the pumping systems. The Corps expects this to take place in the early part of calendar year 2008.

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## Conclusion

The Corps' actions in awarding and administering the pumping system contract were generally in accordance with federal requirements. However, in its haste to award the contract and acquire and install the pumps, the Corps did not develop a contract that was clear and precise with respect to testing and acceptance criteria and did not always promptly prepare required contract related documents. In some cases, this has led to uncertainties about exactly what was required of the contractor to comply with the contract's terms and conditions. This also creates the potential for contract disputes, which can be difficult, expensive, and time-consuming to resolve. In addition, in those cases where required documents were prepared "after the fact," there is an increased likelihood that documents prepared months after events have occurred may contain inaccuracies as memories have faded and key personnel may have moved on to other positions.

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<sup>16</sup>The incentive clause also has a penalty for late delivery of \$1,700 per pump, per day. The Corps will determine whether or not a penalty will be assessed as part of the close-out process.

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## Recommendations for Executive Action

While we recognize that this procurement was conducted under exigent circumstances, we believe that the procedures used by the Corps could be improved for future procurements. For this reason we recommend that the Secretary of Defense direct the Commanding General and Chief of Engineers of the U.S. Army Corps of Engineers to:

- take steps, through additional guidance or otherwise, to reinforce the importance of adherence to sound acquisition practices, even during expedited procurements, including ensuring that important contract provisions, such as any required testing, are clear so that the contractor and the government understand what conditions or criteria must be met for successful completion of the contract; and
- develop procedures to ensure that any required contract-related documentation, including that related to contract pricing, is completed and filed within a reasonable period of time.

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## Agency Comments and Our Evaluation

The Department of Defense provided written comments on a draft of this report, which are reprinted in appendix III. The Department of Defense concurred with our recommendations and provided information on what actions it would take to address them. Concerning our recommendation to adhere to sound acquisition practices, the Department of Defense said the Secretary of Defense will direct the Corps to send guidance to all Corps offices emphasizing the need for clearer technical specifications so that the contractor and government understand what conditions or criteria must be met for successful contract completion. To address our recommendation to ensure more timely completion of required contract file documentation, the Department of Defense said the Secretary of Defense will direct the Corps to review and revise as necessary current policies and regulations. The Department of Defense also provided us with technical comments, which we have incorporated throughout the report, as appropriate.

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As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to interested congressional committees; the Secretary of Defense; and the Commanding General and Chief of Engineers of the U.S. Army Corps of Engineers. We will also make copies available to others on request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or any of your staff have any questions about this report, please contact one of us at (202) 512-3841 or [mittala@gao.gov](mailto:mittala@gao.gov), (202) 512-4841 or [woodsw@gao.gov](mailto:woodsw@gao.gov), or (202) 512-6923 or [dornt@gao.gov](mailto:dornt@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix IV.

Sincerely yours,



Anu K. Mittal  
Director, Natural Resources and Environment



William T. Woods  
Director, Acquisition and Sourcing Management



Terrell G. Dorn  
Director, Physical Infrastructure



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# Appendix I: Scope and Methodology

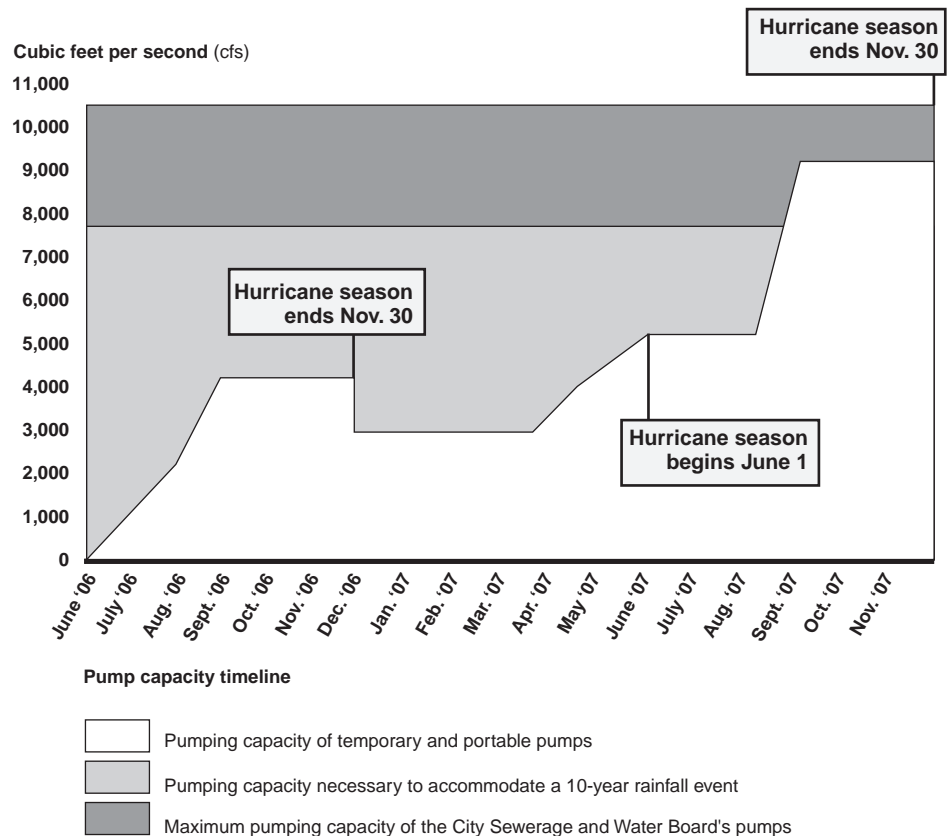
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To evaluate efforts by the U.S. Army Corps of Engineers (Corps) to solicit, award, and administer the pumping system contract, we reviewed the Corps' plans for the interim gates and temporary pumping systems consisting of the 40 hydraulic pumps installed at the three New Orleans drainage canals. We also reviewed applicable Federal Acquisition Regulation criteria, especially pertaining to contract pricing; the contract and specifications; e-mails, correspondence, and other supporting documentation related to the solicitation and award of the contract; factory and on-site test results; performance requirements; the 32 contract modifications and supporting documentation; the Mississippi Valley Division (MVD) Independent Team Report (ITR); the Corps project delivery team's response to the ITR; contractor invoices and payment records; and the Corps' plans for increasing pumping capacity through 2007.

We also visited the 17th Street, London Avenue, and Orleans Avenue Canals and observed the operation of the pumping systems. We interviewed contracting and program officials from (1) Corps Headquarters, New Orleans District, other Corps districts, and members of the MVD's technical review team related to the contract and pump performance; (2) Moving Water Industries Corporation and two other pump suppliers that bid on the solicitation; and (3) the architectural and engineering consulting firms under contract with the Corps that researched available pumping system alternatives, including qualified pump manufactures, pump delivery timelines, and costs, and that helped design the canal gates and pumping stations. We conducted our work from September through December 2007 in accordance with generally accepted government auditing standards.

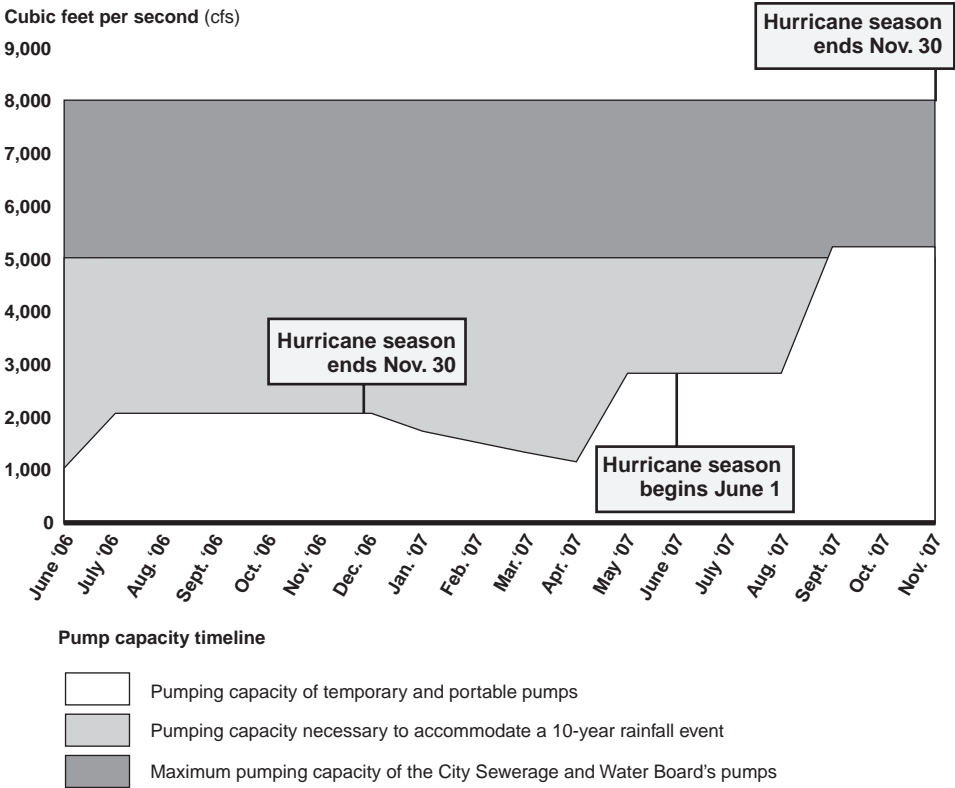
# Appendix II: Pumping Capacity for the Three Drainage Canals

**Figure 9: Pumping Capacity Trend for the 17th Street Canal, June 1, 2006 through November 30, 2007**



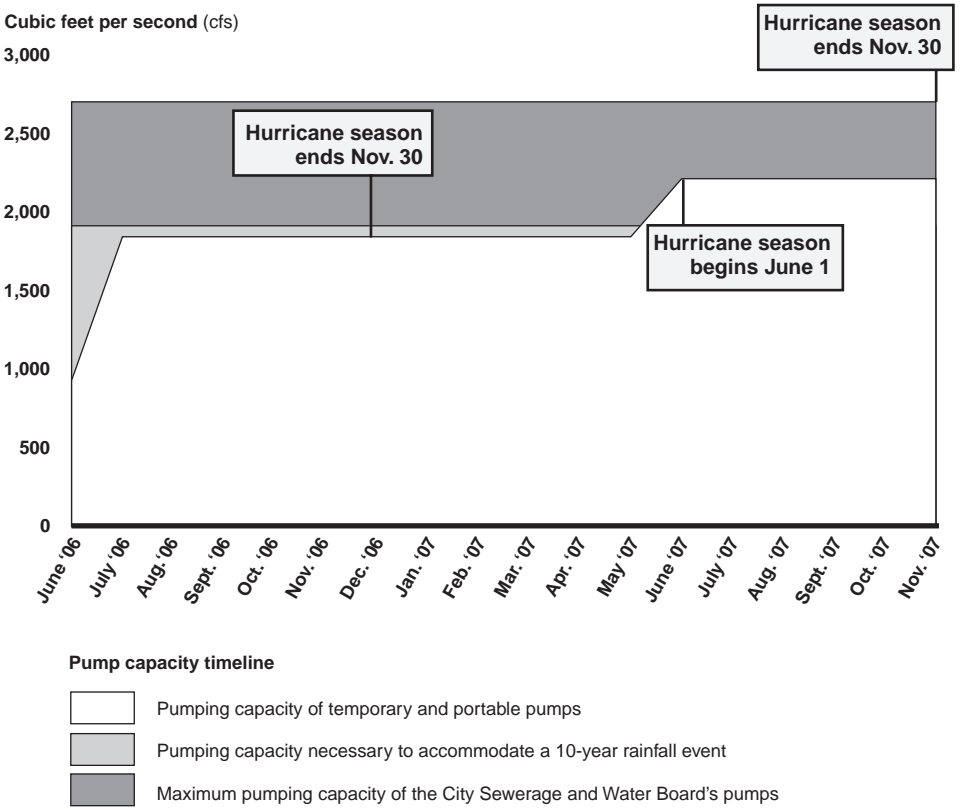
Source: GAO analysis of U.S. Army Corps of Engineers' data.

**Figure 10: Pumping Capacity Trend for the London Avenue Canal, June 1, 2006 through November 30, 2007**



Source: GAO analysis of U.S. Army Corps of Engineers' data.

**Figure 11: Pumping Capacity Trend for the Orleans Avenue Canal, June 1, 2006 through November 30, 2007**



Source: GAO analysis of U.S. Army Corps of Engineers' data.

# Appendix III: Comments from the Department of Defense



DEPARTMENT OF THE ARMY  
U.S. ARMY CORPS OF ENGINEERS  
441 G ST. NW  
WASHINGTON, D.C. 20314-1000

December 18, 2007

Internal Review Office

Ms. Anu K. Mittal  
Director, Natural Resources  
And Environment  
Government Accountability Office  
441 G Street, N.W.  
Washington, D.C. 20548


Dear Ms. Mittal:

This is the Department of Defense (DoD) response to the GAO draft report 08-288, 'ARMY CORPS OF ENGINEERS: Known Performance Issues with New Orleans Drainage Canal Pumps Have Been Addressed, but Guidance on Future Contracts Is Needed,' dated December 4, 2007, (GAO Code 360879).

We appreciate the opportunity for reviewing the draft report. Command comments to the report recommendations are contained in the attachment.

If you have any questions or require additional information, please contact Ms. Alicia Matias, 202-761-4573, [alicia.s.matias@usace.army.mil](mailto:alicia.s.matias@usace.army.mil).

Enclosure  
As Stated

  
DONNA F. JOHNSON  
Acting Chief Audit Executive  
HQ Internal Review Office

**GAO DRAFT REPORT 08-288, 'ARMY CORPS OF ENGINEERS:  
KNOWN PERFORMANCE ISSUES WITH NEW ORLEANS  
DRAINAGE CANAL PUMPS HAVE BEEN ADDRESSED, BUT  
GUIDANCE ON FUTURE CONTRACTS IS NEEDED,' DATED  
DECEMBER 4, 2007, (GAO CODE 360879)**

**DEPARTMENT OF DEFENSE RESPONSE TO THE  
RECOMMENDATIONS**

Recommendation: We recommend that the Secretary of Defense require the Chief of Engineers to:

Take steps, through additional guidance or otherwise, to reinforce the importance of adherence to sound acquisition practices even during expedited procurements, including ensuring that important contract provisions, such as any required testing, are clear and that the contractor and the government understand what conditions or criteria must be met for successful completion of the contract.

**DOD RESPONSE: CONCUR:** The Secretary of Defense will direct the U.S. Army Corps of Engineers to send a memo to all Corps offices reinforcing the importance of adherence to sound engineering practices even during expedited procurements. The memo will relate lessons learned and emphasize the need for technical specifications, such as those required for equipment testing, to be clear so that the contractor and the government understand what conditions or criteria must be met for successful completion of the contract. The anticipated date to transmit the memo is 11 January, 2008.

Develop procedures to ensure that any contract related documentation, including that related to contract pricing, is completed and filed within a reasonable period of time.

**DOD RESPONSE: CONCUR:** The Secretary of Defense will direct the U.S. Army Corps of Engineers to review and revise, as necessary, current policies and regulations to ensure that a reasonable period of time is identified for completing and filing contract documents. Estimated completion date is 30 May, 2008.

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# Appendix IV: GAO Contacts and Staff Acknowledgments

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## GAO Contacts

Anu K. Mittal, (202) 512-3841 or [mittala@gao.gov](mailto:mittala@gao.gov)  
William T. Woods, (202) 512-4841 or [woodsw@gao.gov](mailto:woodsw@gao.gov)  
Terrell G. Dorn, (202) 512-6923 or [dornt@gao.gov](mailto:dornt@gao.gov)

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## Staff Acknowledgments

In addition to the contacts named above, Ed Zadjura, Assistant Director; Matthew Reinhart; Katherine Trimble; Christine Frye; James Dishmon; Rich Johnson; Marie P. Ahearn; and Kenneth E. Patton made significant contributions to this report.

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